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Effect of Surface Irregularities on Bellows Fatigue Life

A report has been prepared which presents test data on the bending fatigue life of notched CRES sheet specimens. While the information is potentially useful in various fields, the report is directed toward the quantitative evaluation of bellows defects, particularly those resulting from accidental damage.

The influence of a surface irregularity on the fatigue life of a metal bellows is difficult to evaluate. The problem arises mainly from lack of appropriate data on fatigue life of notched sheet materials. Compounding the difficulty is the performance deviation inherent in nominally identical bellows because of dimensional and material irregularities which exist under the present state of the fabricating art. The indefinite duty cycle spectrum in many bellows applications contributes a share of uncertainty to any fatigue life prediction. The wide range of surface irregularities presented for evaluation is, in itself, testimony to the lack of definition which exists. Between the superficial mark and the contour-destroying blow, these irregularities progress in fine gradation. The evaluator must make the determination.

The use of the term "surface irregularity" is often preferred to the term "defect" as it has less tendency to prejudice judgment of the anomaly. The distinction is not preserved in the report; both terms are employed interchangeably. Bellows defects should be considered under two categories: (1) manufacturing defects, which are those more or less consistently produced by a deficiency in the manufacturing process;

and (2) accidental defects, those which occur as the result of the human element. Manufacturing defects (examples of which are tool marks and orange peel) eventually can be eliminated or reduced to an acceptable level by appropriate changes to processes and process control. Accidental defects in ducting bellows, to the evaluation of which the report is mainly applicable, are impossible to avoid short of completely eliminating human contact. Control is maintained only at the expense of a scrap rate which rises and falls as discipline is relaxed or tightened. Although considerable effort has gone into protective covers, packaging, and educational programs regarding the seriousness of bellows damage, it is still not 100-percent effective.

Note:

Copies of the complete report are available from:

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No patent action is contemplated by NASA.

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